**//DESIGN CODE**

module elevator\_controller (

input logic clk,

input logic rst,

input logic [3:0] req, // Requests for floors 0 to 3

input logic overweight, // 1 = too heavy, do not close doors

output logic [1:0] current\_floor,

output logic door\_open,

output logic moving

)

// State encoding using enum

typedef enum logic [1:0] {

IDLE = 2'd0,

CLOSE\_DOOR = 2'd1,

MOVE = 2'd2

} state\_t;

state\_t state;

logic [1:0] next\_floor;

// Priority encoder to get requested floor

function automatic logic [1:0] get\_requested\_floor(input logic [3:0] req);

if (req[3]) return 2'd3;

else if (req[2]) return 2'd2;

else if (req[1]) return 2'd1;

else return 2'd0;

endfunction

// Sequential logic

always\_ff @(posedge clk or posedge rst) begin

if (rst) begin

current\_floor <= 2'd0;

door\_open <= 1;

moving <= 0;

state <= IDLE;

next\_floor <= 2'd0;

end else begin

unique case (state)

IDLE: begin

moving <= 0;

door\_open <= 1;

if (!overweight && req != 0) begin

next\_floor <= get\_requested\_floor(req);

if (next\_floor != current\_floor) begin

door\_open <= 0;

state <= CLOSE\_DOOR;

end

end

end

CLOSE\_DOOR: begin

door\_open <= 0;

moving <= 1;

state <= MOVE;

end

MOVE: begin

if (current\_floor == next\_floor) begin

moving <= 0;

door\_open <= 1;

state <= IDLE;

end else begin

if (current\_floor < next\_floor)

current\_floor <= current\_floor + 1;

else

current\_floor <= current\_floor - 1;

end

end

endcase

end

end

endmodule

**//TESTBENCH**

//=====================================================

// Interface

//=====================================================

interface elevator\_if(input logic clk);

logic rst;

logic [3:0] req;

logic overweight;

logic [1:0] current\_floor;

logic door\_open;

logic moving;

endinterface

//=====================================================

// Transaction

//=====================================================

class elevator\_tx;

rand logic [3:0] req;

rand logic overweight;

function void display(string tag="");

$display("[%0t] %s | Req=%b Overweight=%b",

$time, tag, req, overweight);

endfunction

endclass

//=====================================================

// Generator

//=====================================================

class generator;

mailbox gen2drv;

function new(mailbox gen2drv);

this.gen2drv = gen2drv;

endfunction

task run();

elevator\_tx tx;

// Transaction 1: request floor 3 but overweight=1

tx = new(); tx.req = 4'b1000; tx.overweight = 1;

gen2drv.put(tx);

// Transaction 2: clear overweight

#20;

tx = new(); tx.req = 4'b1000; tx.overweight = 0;

gen2drv.put(tx);

// Transaction 3: clear request

#20;

tx = new(); tx.req = 4'b0000; tx.overweight = 0;

gen2drv.put(tx);

// Transaction 4: request floor 1 from floor 3

#100;

tx = new(); tx.req = 4'b0010; tx.overweight = 0;

gen2drv.put(tx);

// Transaction 5: clear request

#20;

tx = new(); tx.req = 4'b0000; tx.overweight = 0;

gen2drv.put(tx);

endtask

endclass

//=====================================================

// Driver

//=====================================================

class driver;

virtual elevator\_if vif;

mailbox gen2drv;

function new(virtual elevator\_if vif, mailbox gen2drv);

this.vif = vif;

this.gen2drv = gen2drv;

endfunction

task run();

elevator\_tx tx;

forever begin

gen2drv.get(tx);

vif.req = tx.req;

vif.overweight = tx.overweight;

tx.display("DRIVER");

#10;

end

endtask

endclass

//=====================================================

// Monitor

//=====================================================

class monitor;

virtual elevator\_if vif;

mailbox mon2scb;

function new(virtual elevator\_if vif, mailbox mon2scb);

this.vif = vif;

this.mon2scb = mon2scb;

endfunction

task run();

forever begin

#10;

$display("MONITOR: Floor=%0d Door=%0b Moving=%0b Req=%b Overweight=%b",

vif.current\_floor, vif.door\_open, vif.moving,

vif.req, vif.overweight);

mon2scb.put({vif.current\_floor, vif.door\_open, vif.moving});

end

endtask

endclass

//=====================================================

// Scoreboard

//=====================================================

class scoreboard;

mailbox mon2scb;

function new(mailbox mon2scb);

this.mon2scb = mon2scb;

endfunction

task run();

logic [3:0] data;

forever begin

mon2scb.get(data);

$display("SCOREBOARD: Observed = %b", data);

end

endtask

endclass

//=====================================================

// Environment

//=====================================================

class environment;

generator gen;

driver drv;

monitor mon;

scoreboard scb;

mailbox gen2drv, mon2scb;

virtual elevator\_if vif;

function new(virtual elevator\_if vif);

this.vif = vif;

gen2drv = new();

mon2scb = new();

gen = new(gen2drv);

drv = new(vif, gen2drv);

mon = new(vif, mon2scb);

scb = new(mon2scb);

endfunction

task run();

fork

gen.run();

drv.run();

mon.run();

scb.run();

join\_any

endtask

endclass

//=====================================================

// Test

//=====================================================

program test(elevator\_if vif);

environment env;

initial begin

env = new(vif);

env.run();

#500 $finish;

end

endprogram

//=====================================================

// Top Module

//=====================================================

module tb\_top;

logic clk;

always #5 clk = ~clk;

elevator\_if intf(clk);

// DUT

elevator\_controller dut (

.clk(clk),

.rst(intf.rst),

.req(intf.req),

.overweight(intf.overweight),

.current\_floor(intf.current\_floor),

.door\_open(intf.door\_open),

.moving(intf.moving)

);

// Test

test t(intf);

initial begin

clk = 0;

intf.rst = 1;

intf.req = 0;

intf.overweight = 0;

#10 intf.rst = 0;

end

// VCD dump

initial begin

$dumpfile("elevator\_class\_tb.vcd");

$dumpvars(0, tb\_top);

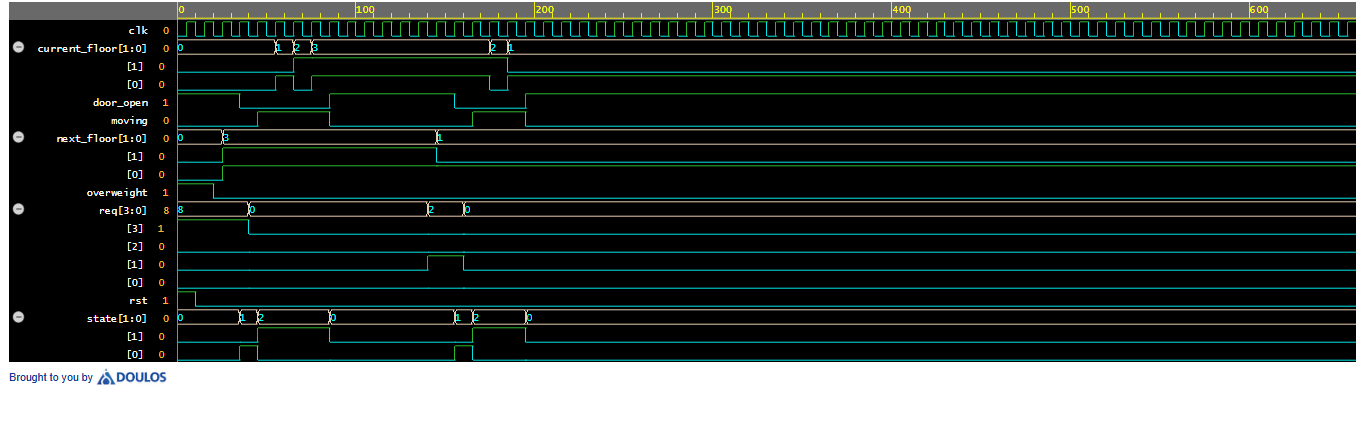
end

endmodule

**//TCL OUTPUT**

[0] DRIVER | Req=1000 Overweight=1  
MONITOR: Floor=0 Door=1 Moving=0 Req=1000 Overweight=1  
SCOREBOARD: Observed = 0010  
MONITOR: Floor=0 Door=1 Moving=0 Req=1000 Overweight=1  
[20] DRIVER | Req=1000 Overweight=0  
SCOREBOARD: Observed = 0010  
MONITOR: Floor=0 Door=1 Moving=0 Req=1000 Overweight=0  
SCOREBOARD: Observed = 0010  
MONITOR: Floor=0 Door=0 Moving=0 Req=1000 Overweight=0  
[40] DRIVER | Req=0000 Overweight=0  
SCOREBOARD: Observed = 0000  
MONITOR: Floor=0 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0001  
MONITOR: Floor=1 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0101  
MONITOR: Floor=2 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1001  
MONITOR: Floor=3 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1101  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0000 Overweight=0  
[140] DRIVER | Req=0010 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=1 Moving=0 Req=0010 Overweight=0  
SCOREBOARD: Observed = 1110  
MONITOR: Floor=3 Door=0 Moving=0 Req=0010 Overweight=0  
[160] DRIVER | Req=0000 Overweight=0  
SCOREBOARD: Observed = 1100  
MONITOR: Floor=3 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1101  
MONITOR: Floor=2 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 1001  
MONITOR: Floor=1 Door=0 Moving=1 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0101  
MONITOR: Floor=1 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0110  
MONITOR: Floor=1 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0110  
MONITOR: Floor=1 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0110  
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SCOREBOARD: Observed = 0110  
MONITOR: Floor=1 Door=1 Moving=0 Req=0000 Overweight=0  
SCOREBOARD: Observed = 0110

**//WAVEFORM**

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